

Appendix 3-A

U.S. FDA – Total Diet Study

**Source: U.S. Department of Food and Agriculture, 2000.
Total Diet Study Statistics on Element Results. p. 13.**

Total Diet Study Statistics on Element Results

U.S. Food and Drug Administration
Washington, DC

Na	Mg												P				
K	Ca				Mn	Fe		Ni	Cu	Zn			As	Se			
										Cd							
										Hg		Pb					

Revision 1, 1991-1998
April 25, 2000

US Food and Drug Administration — Total Diet Study — Market Baskets 91-3 through 99-1

Lead - Summary of Results

TDS Food Description	TDS	Number		Mean	Standard	Minimum	Maximum	Median	
	Food No.	Number of Results	Not Detected						Number of Traces
Overall:		6777	5136	1474	0.004	0.010	0	0.210	0
whole milk, fluid	1	26	23	3	0.001	0.003	0	0.011	0
lowfat (2% fat) milk, fluid	2	26	23	3	0.001	0.004	0	0.012	0
chocolate milk, fluid	3	26	24	2	0.001	0.003	0	0.013	0
skim milk, fluid	4	26	23	3	0.001	0.004	0	0.017	0
plain yogurt, lowfat	6	26	24	2	0.001	0.002	0	0.008	0
chocolate milk shake, fast-food	7	26	12	13	0.009	0.009	0	0.023	0.009
evaporated milk, canned	8	26	24	2	0.001	0.004	0	0.019	0
American, processed cheese	10	26	25	1	0.001	0.004	0	0.018	0
cottage cheese, 4% milkfat	11	26	19	6	0.004	0.007	0	0.030	0
cheddar cheese	12	26	23	3	0.002	0.006	0	0.021	0
ground beef, pan-cooked	13	26	24	1	0.002	0.008	0	0.040	0
beef chuck roast, baked	14	26	21	5	0.003	0.006	0	0.020	0
beef steak, loin, pan-cooked	16	26	22	4	0.003	0.006	0	0.020	0
ham, baked	17	26	23	3	0.002	0.005	0	0.020	0
pork chop, pan-cooked	18	26	23	3	0.001	0.004	0	0.014	0
pork sausage, pan-cooked	19	26	22	4	0.003	0.008	0	0.026	0
pork bacon, pan-cooked	20	26	22	4	0.003	0.008	0	0.027	0
pork roast, baked	21	26	24	2	0.002	0.006	0	0.030	0
lamb chop, pan-cooked	22	26	22	4	0.002	0.005	0	0.020	0
chicken, fried (breast, leg, and thigh) homemade	24	26	24	2	0.002	0.006	0	0.030	0
turkey breast, roasted	26	26	26	0	0	0	0	0	0
liver, beef, fried	27	26	0	22	0.030	0.019	0.014	0.080	0.024
frankfurters, beef, boiled	28	26	21	5	0.005	0.010	0	0.032	0
bologna, sliced	29	26	23	3	0.002	0.005	0	0.020	0
salami, sliced	30	26	24	2	0.001	0.004	0	0.016	0
tuna, canned in oil	32	26	23	3	0.001	0.004	0	0.013	0
fish sticks, frozen, heated	34	26	24	2	0.001	0.003	0	0.011	0

US Food and Drug Administration — Total Diet Study — Market Baskets 91-3 through 99-1

Lead - Summary of Results

TDS Food Description	TDS	Number		Mean (mg/kg)	Standard Deviation (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)	Median (mg/kg)	
	Food No.	Number of Results	Not Detected						Number of Traces
eggs, scrambled	35	26	25	1	0	0.002	0	0.009	0
eggs, fried	36	26	25	1	0	0.002	0	0.009	0
eggs, boiled	37	26	24	2	0.001	0.003	0	0.013	0
pinto beans, dry, boiled	38	26	23	3	0.001	0.004	0	0.014	0
pork and beans, canned	39	26	20	6	0.002	0.005	0	0.018	0
lima beans, immature, frozen, boiled	42	26	21	5	0.002	0.005	0	0.020	0
green peas, fresh/frozen, boiled	46	26	21	5	0.002	0.005	0	0.020	0
peanut butter, smooth	47	26	22	4	0.003	0.006	0	0.019	0
peanuts, dry roasted	48	26	25	1	0.001	0.003	0	0.017	0
white rice, cooked	50	26	21	4	0.003	0.007	0	0.030	0
oatmeal, quick (1-3 min), cooked	51	26	24	2	0.001	0.002	0	0.009	0
wheat cereal, farina, quick (1-3min), cooked	52	26	21	5	0.003	0.006	0	0.022	0
corngrits, regular, cooked	53	26	22	4	0.002	0.006	0	0.024	0
corn, fresh/frozen, boiled	54	26	23	3	0.001	0.004	0	0.014	0
cream style corn, canned	56	26	20	6	0.003	0.006	0	0.020	0
popcorn, popped in oil	57	26	19	7	0.005	0.009	0	0.03	0
white bread	58	26	20	6	0.003	0.006	0	0.016	0
white roll	59	26	15	11	0.007	0.009	0	0.024	0
cornbread, homemade	60	26	15	11	0.006	0.007	0	0.017	0
biscuit, from refrigerated dough, baked	61	26	15	11	0.005	0.006	0	0.016	0
whole wheat bread	62	26	15	11	0.005	0.006	0	0.018	0
tortilla, flour	63	26	20	6	0.004	0.007	0	0.024	0
rye bread	64	26	20	6	0.004	0.008	0	0.030	0
blueberry muffin, commercial	65	26	20	6	0.003	0.005	0	0.015	0
saltine crackers	66	26	20	6	0.005	0.009	0	0.028	0
corn chips	67	26	25	1	0.001	0.003	0	0.014	0
pancake from mix	68	26	18	8	0.004	0.006	0	0.020	0
egg noodles, boiled	69	26	17	9	0.003	0.005	0	0.014	0
macaroni, boiled	70	26	20	6	0.002	0.004	0	0.009	0
corn flakes	71	26	22	4	0.002	0.004	0	0.013	0

US Food and Drug Administration — Total Diet Study — Market Baskets 91-3 through 99-1

Lead - Summary of Results

TDS Food Description	TDS	Number		Mean	Standard	Minimum	Maximum	Median	
	Food No.	Number of Results	Not Detected						Number of Traces
fruit-flavored, sweetened cereal	72	26	20	5	0.004	0.011	0	0.050	0
shredded wheat cereal	73	26	25	1	0.001	0.005	0	0.026	0
raisin bran cereal	74	26	16	10	0.007	0.010	0	0.036	0
crisped rice cereal	75	26	22	4	0.003	0.007	0	0.030	0
granola cereal	76	26	14	12	0.006	0.007	0	0.026	0
oat ring cereal	77	26	14	12	0.006	0.007	0	0.027	0
apple, red, raw	78	26	20	6	0.002	0.004	0	0.013	0
orange, raw	79	26	22	4	0.002	0.004	0	0.012	0
banana, raw	80	26	23	3	0.001	0.003	0	0.008	0
watermelon, raw	81	26	24	2	0	0.001	0	0.005	0
peach, raw	83	26	19	6	0.003	0.007	0	0.030	0
applesauce, bottled	84	26	24	2	0.001	0.002	0	0.008	0
pear, raw	85	26	25	1	0	0.002	0	0.008	0
strawberries, raw	86	26	23	3	0.001	0.003	0	0.009	0
fruit cocktail, canned in heavy syrup	87	26	0	19	0.025	0.017	0.008	0.064	0.019
grapes, red/green, seedless, raw	88	26	19	7	0.003	0.005	0	0.019	0
cantaloupe, raw	89	26	23	3	0.001	0.004	0	0.014	0
plums, raw	91	26	21	5	0.001	0.003	0	0.011	0
grapefruit, raw	92	26	22	4	0.001	0.003	0	0.013	0
pineapple, canned in juice	93	26	4	13	0.012	0.008	0	0.030	0.010
sweet cherries, raw	94	20	17	3	0.002	0.005	0	0.018	0
raisins, dried	95	26	10	16	0.011	0.011	0	0.030	0.010
prunes, dried	96	26	18	7	0.006	0.010	0	0.040	0
avocado, raw	97	26	24	2	0.002	0.009	0	0.040	0
orange juice, from frozen concentrate	98	26	24	1	0.001	0.005	0	0.020	0
apple juice, bottled	99	26	11	15	0.005	0.005	0	0.018	0.005
grapefruit juice, from frozen concentrate	100	26	26	0	0	0	0	0	0
prune juice, bottled	103	26	18	7	0.004	0.011	0	0.054	0
lemonade, from frozen concentrate	105	26	25	1	0	0.001	0	0.006	0
spinach, fresh/frozen, boiled	107	26	7	16	0.012	0.012	0	0.040	0.009

US Food and Drug Administration — Total Diet Study — Market Baskets 91-3 through 99-1

Lead - Summary of Results

TDS Food Description	TDS	Number		Mean	Standard	Minimum	Maximum	Median	
	Food No.	Number of Results	Not Detected						Number of Traces
collards, fresh/frozen, boiled	108	26	4	21	0.011	0.008	0	0.040	0.009
iceberg lettuce, raw	109	26	25	1	0	0.001	0	0.006	0
cabbage, fresh, boiled	110	26	26	0	0	0	0	0	0
coleslaw with dressing, homemade	111	26	24	2	0.001	0.003	0	0.011	0
sauerkraut, canned	112	26	14	9	0.010	0.017	0	0.069	0
broccoli, fresh/frozen, boiled	113	26	24	2	0.001	0.003	0	0.014	0
celery, raw	114	26	23	3	0.001	0.003	0	0.012	0
asparagus, fresh/frozen, boiled	115	26	20	7	0.002	0.005	0	0.014	0
cauliflower, fresh/frozen, boiled	116	26	24	2	0.001	0.003	0	0.011	0
tomato, red, raw	117	26	26	0	0	0	0	0	0
tomato sauce, plain, bottled	119	26	18	8	0.005	0.007	0	0.020	0
green beans, fresh/frozen, boiled	121	26	23	2	0.002	0.005	0	0.020	0
cucumber, raw	123	26	25	0	0.001	0.006	0	0.030	0
summer squash, fresh/frozen, boiled	124	26	25	1	0.001	0.004	0	0.020	0
green pepper, raw	125	26	25	1	0.001	0.003	0	0.014	0
winter squash, fresh/frozen, baked, mashed	126	26	23	3	0.001	0.003	0	0.014	0
onion, mature, raw	128	26	24	2	0.001	0.004	0	0.018	0
radish, raw	132	26	25	1	0	0.002	0	0.009	0
French fries, frozen, heated	134	26	25	1	0.001	0.004	0	0.020	0
mashed potatoes, from flakes	135	26	26	0	0	0	0	0	0
white potato, boiled without skin	136	26	26	0	0	0	0	0	0
white potato, baked with skin	137	26	20	6	0.003	0.006	0	0.020	0
potato chips	138	26	23	3	0.003	0.008	0	0.032	0
scalloped potatoes, homemade	139	26	25	1	0.001	0.003	0	0.014	0
sweet potato, fresh, baked	140	26	7	16	0.014	0.015	0	0.064	0.011
spaghetti with tomato sauce and meatballs, homemade	142	26	24	0	0.001	0.002	0	0.008	0
beef stew with potatoes, carrots, and onion, homemade	143	26	24	2	0.001	0.003	0	0.010	0
macaroni and cheese, from box mix	146	26	23	3	0.001	0.003	0	0.011	0

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Lead - Summary of Results

TDS Food Description	TDS	Number		Mean	Standard	Minimum	Maximum	Median	
	Food No.	Number of Results	Not Detected						Number of Traces
quarter-pound hamburger on bun, fast-food	147	26	21	4	0.008	0.031	0	0.160	0
meatloaf, homemade	148	26	22	4	0.002	0.005	0	0.016	0
spaghetti with tomato sauce, canned	149	26	21	5	0.002	0.004	0	0.013	0
lasagna with meat, homemade	151	26	21	5	0.002	0.004	0	0.013	0
chicken potpie, frozen, heated	152	26	23	3	0.001	0.004	0	0.013	0
chicken noodle soup, canned, condensed, prepared with water	155	26	19	6	0.005	0.010	0	0.041	0
tomato soup, canned, condensed, prepared with water	156	26	23	3	0.001	0.003	0	0.009	0
vegetable beef soup, canned, condensed, prepared with water	157	26	24	2	0.001	0.003	0	0.010	0
white sauce, homemade	160	26	24	1	0.002	0.010	0	0.050	0
dill cucumber pickles	161	26	4	19	0.022	0.018	0	0.064	0.020
margarine, stick, regular (salted)	162	26	24	2	0.003	0.011	0	0.044	0
butter, regular (salted)	164	26	26	0	0	0	0	0	0
mayonnaise, regular, bottled	166	26	23	2	0.005	0.016	0	0.067	0
half & half cream	167	26	26	0	0	0	0	0	0
cream substitute, frozen	168	26	19	7	0.004	0.008	0	0.030	0
white sugar, granulated	169	26	25	1	0.001	0.004	0	0.018	0
pancake syrup	170	26	18	8	0.004	0.007	0	0.019	0
honey	172	26	2	19	0.023	0.011	0	0.040	0.021
tomato catsup	173	26	20	5	0.005	0.010	0	0.040	0
chocolate pudding, from instant mix	175	26	14	12	0.005	0.006	0	0.015	0
vanilla flavored light ice cream	177	26	23	3	0.001	0.003	0	0.011	0
chocolate cake with chocolate icing, commercial	178	26	7	19	0.009	0.007	0	0.026	0.009
yellow cake with white icing, prepared from cake and icing mixes	179	26	19	7	0.003	0.005	0	0.013	0
sweet roll/Danish, commercial	182	26	15	11	0.005	0.007	0	0.024	0
chocolate chip cookies, commercial	183	26	1	25	0.013	0.005	0	0.023	0.013

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Lead - Summary of Results

TDS Food Description	TDS	Number		Mean	Standard	Minimum	Maximum	Median	
	Food No.	Number of Results	Not Detected						Number of Traces
sandwich cookies with creme filling, commercial	184	26	10	14	0.010	0.010	0	0.040	0.010
apple pie, fresh/frozen, commercial	185	26	12	13	0.009	0.013	0	0.060	0.010
pumpkin pie, fresh/frozen, commercial	186	26	14	12	0.007	0.007	0	0.020	0
milk chocolate candy bar, plain	187	26	2	19	0.027	0.021	0	0.110	0.021
caramel candy	188	26	22	4	0.003	0.007	0	0.030	0
gelatin dessert, any flavor	190	26	22	3	0.002	0.005	0	0.020	0
cola carbonated beverage	191	26	26	0	0	0	0	0	0
fruit drink, from powder	193	26	26	0	0	0	0	0	0
low-calorie cola carbonated beverage	194	26	26	0	0	0	0	0	0
coffee, decaffeinated, from instant	196	26	25	1	0	0.002	0	0.010	0
tea, from tea bag	197	26	24	2	0	0.001	0	0.005	0
beer	198	26	26	0	0	0	0	0	0
dry table wine	199	26	1	7	0.021	0.012	0	0.060	0.018
whiskey	200	26	24	1	0.002	0.010	0	0.049	0
tap water	201	26	25	1	0	0.001	0	0.004	0
milk-based infant formula, high iron, ready-to-feed	202	26	26	0	0	0	0	0	0
milk-based infant formula, low iron, ready-to-feed	203	26	26	0	0	0	0	0	0
beef, strained/junior	205	26	22	3	0.005	0.018	0	0.090	0
chicken, strained/junior, with/without broth or gravy	207	26	19	7	0.003	0.006	0	0.020	0
chicken/turkey with vegetables, high/lean meat, strained/junior	208	2	1	1	0.006	0.009	0	0.013	0.006
beef with vegetables, high/lean meat, strained/junior	209	2	1	1	0.006	0.008	0	0.012	0.006
ham with vegetables, high/lean meat, strained/junior	210	2	2	0	0	0	0	0	0
vegetables and beef, strained/junior	211	26	22	4	0.001	0.004	0	0.014	0

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Lead - Summary of Results

TDS Food Description	TDS	Number		Mean	Standard	Minimum	Maximum	Median	
	Food No.	Number of Results	Not Detected						Number of Traces
vegetables and chicken, strained/junior	212	26	22	3	0.005	0.017	0	0.088	0
vegetables and ham, strained/junior	213	26	22	4	0.002	0.004	0	0.013	0
chicken noodle dinner, strained/junior	214	25	16	9	0.004	0.005	0	0.011	0
macaroni, tomatoes, and beef, strained/junior	215	26	20	6	0.002	0.005	0	0.014	0
turkey and rice, strained/junior	216	26	20	6	0.003	0.006	0	0.020	0
carrots, strained/junior	218	26	12	14	0.006	0.006	0	0.018	0.008
green beans, strained/junior	219	26	18	8	0.003	0.004	0	0.012	0
mixed vegetables, strained/junior	220	26	18	8	0.003	0.005	0	0.014	0
sweet potatoes, strained/junior	221	26	0	14	0.023	0.007	0.010	0.039	0.022
creamed corn, strained/junior	222	26	25	1	0	0.002	0	0.011	0
peas, strained/junior	223	26	26	0	0	0	0	0	0
creamed spinach, strained/junior	224	26	11	15	0.006	0.006	0	0.020	0.007
applesauce, strained/junior	225	26	22	4	0.002	0.004	0	0.012	0
peaches, strained/junior	226	26	23	3	0.001	0.004	0	0.015	0
pears, strained/junior	227	26	17	9	0.004	0.006	0	0.020	0
apple juice, strained	230	26	23	3	0.001	0.002	0	0.007	0
orange juice, strained	231	26	26	0	0	0	0	0	0
custard pudding, strained/junior	232	26	26	0	0	0	0	0	0
fruit dessert/pudding, strained/junior	233	26	23	3	0.001	0.003	0	0.010	0
fruit-flavored yogurt, lowfat (fruit mixed in)	235	26	19	6	0.004	0.007	0	0.030	0
Swiss cheese	236	26	21	5	0.003	0.007	0	0.028	0
cream cheese	237	26	22	4	0.003	0.006	0	0.024	0
veal cutlet, pan-cooked	238	26	21	5	0.003	0.006	0	0.016	0
ham luncheon meat, sliced	239	26	23	3	0.002	0.005	0	0.019	0
chicken breast, roasted	240	26	23	3	0.001	0.004	0	0.015	0
chicken nuggets, fast-food	241	26	21	5	0.002	0.005	0	0.016	0
chicken, fried (breast, leg, and thigh), fast-food	242	26	22	4	0.003	0.008	0	0.030	0
haddock, pan-cooked	243	20	16	4	0.003	0.007	0	0.022	0
shrimp, boiled	244	26	7	12	0.032	0.048	0	0.210	0.015
kidney beans, dry, boiled	245	26	22	3	0.002	0.006	0	0.030	0

US Food and Drug Administration — Total Diet Study — Market Baskets 91-3 through 99-1

Lead - Summary of Results

TDS Food Description	TDS	Number		Mean	Standard	Minimum	Maximum	Median	
	Food No.	Number of Results	Not Detected						Number of Traces
peas, mature, dry, boiled	246	26	21	5	0.002	0.005	0	0.015	0
mixed nuts, no peanuts, dry roasted	247	26	19	6	0.009	0.020	0	0.090	0
cracked wheat bread	248	26	20	6	0.003	0.006	0	0.019	0
bagel, plain	249	26	21	5	0.003	0.008	0	0.030	0
English muffin, plain, toasted	250	26	12	14	0.008	0.009	0	0.032	0.010
graham crackers	251	26	10	16	0.010	0.009	0	0.025	0.011
butter-type crackers	252	26	18	8	0.004	0.007	0	0.023	0
apricot, raw	253	21	15	6	0.003	0.005	0	0.014	0
peach, canned in light/medium syrup	254	26	2	14	0.026	0.016	0	0.057	0.020
pear, canned in light syrup	255	26	3	17	0.019	0.016	0	0.067	0.017
pineapple juice, from frozen concentrate	256	26	21	5	0.001	0.003	0	0.010	0
grape juice, from frozen concentrate	257	26	11	13	0.006	0.007	0	0.030	0.005
French fries, fast-food	258	26	20	6	0.003	0.005	0	0.015	0
carrot, fresh, boiled	259	26	20	6	0.002	0.004	0	0.012	0
tomato, stewed, canned	260	26	18	7	0.004	0.008	0	0.028	0
tomato juice, bottled	261	25	19	6	0.003	0.005	0	0.014	0
beets, fresh/frozen, boiled	262	26	19	6	0.004	0.008	0	0.030	0
Brussels sprouts, fresh/frozen, boiled	263	26	21	4	0.004	0.014	0	0.070	0
mushrooms, raw	264	26	21	5	0.002	0.005	0	0.016	0
eggplant, fresh, boiled	265	26	22	2	0.003	0.009	0	0.040	0
turnip, fresh/frozen, boiled	266	26	25	1	0	0.002	0	0.012	0
okra, fresh/frozen, boiled	267	26	22	4	0.002	0.004	0	0.018	0
mixed vegetables, frozen, boiled	268	26	23	2	0.004	0.014	0	0.070	0
beef stroganoff, homemade	269	26	18	6	0.005	0.011	0	0.050	0
green peppers stuffed with beef and rice, homemade	270	26	21	4	0.003	0.008	0	0.030	0
chili con carne with beans, homemade	271	26	19	7	0.004	0.006	0	0.019	0
tuna noodle casserole, homemade	272	26	18	8	0.003	0.005	0	0.019	0
Salisbury steak with gravy, potatoes, and vegetable, frozen meal, heated	273	26	19	7	0.003	0.004	0	0.012	0

US Food and Drug Administration — Total Diet Study — Market Baskets 91-3 through 99-1

Lead - Summary of Results

TDS Food Description	TDS	Number		Mean	Standard	Minimum	Maximum	Median	
	Food No.	Number of Results	Not Detected						Number of Traces
turkey with gravy, dressing, potatoes, and vegetable, frozen meal, heated	274	26	19	6	0.004	0.007	0	0.030	0
quarter-pound cheeseburger on bun, fast-food	275	26	23	2	0.005	0.021	0	0.106	0
fish sandwich on bun, fast-food	276	25	19	6	0.005	0.009	0	0.030	0
frankfurter on bun, fast-food	277	26	17	8	0.006	0.010	0	0.040	0
egg, cheese, and ham on English muffin, fast-food	278	26	21	4	0.004	0.011	0	0.050	0
taco/tostada, from Mexican carry-out	279	26	21	5	0.002	0.005	0	0.020	0
cheese pizza, regular crust, from pizza carry-out	280	26	21	5	0.002	0.005	0	0.013	0
cheese and pepperoni pizza, regular crust, from pizza carry-out	281	26	20	6	0.003	0.005	0	0.015	0
beef chow mein, from Chinese carry-out	282	26	16	10	0.004	0.005	0	0.018	0
bean with bacon/pork soup, canned, condensed, prepared with water	283	26	21	5	0.002	0.004	0	0.011	0
mushroom soup, canned, condensed, prepared with whole milk	284	26	23	3	0.001	0.004	0	0.014	0
clam chowder, New England, canned, condensed, prepared with whole milk	285	26	8	18	0.008	0.007	0	0.023	0.009
vanilla ice cream	286	26	24	2	0.001	0.003	0	0.010	0
fruit flavor sherbet	287	26	19	6	0.003	0.006	0	0.023	0
popsicle, any flavor	288	26	21	4	0.005	0.016	0	0.082	0
chocolate snack cake with chocolate icing	289	26	1	24	0.015	0.006	0	0.025	0.015
cake doughnuts with icing, any flavor, from doughnut store	290	26	16	10	0.004	0.005	0	0.017	0
brownies, commercial	291	26	6	19	0.009	0.006	0	0.021	0.010
sugar cookies, commercial	292	26	20	6	0.002	0.004	0	0.012	0
suckers, any flavor	293	26	21	5	0.004	0.009	0	0.038	0
pretzels, hard, salted, any shape	294	26	21	5	0.005	0.010	0	0.030	0
chocolate syrup dessert topping	295	26	2	21	0.015	0.007	0	0.030	0.016

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Lead - Summary of Results

TDS Food Description	TDS	Number		Mean	Standard	Minimum	Maximum	Median	
	Food No.	Number of Results	Not Detected						Number of Traces
jelly, any flavor	296	26	14	11	0.005	0.006	0	0.026	0
sweet cucumber pickles	297	26	0	13	0.031	0.023	0.007	0.115	0.022
yellow mustard	298	26	11	11	0.009	0.010	0	0.030	0.008
black olives	299	26	11	15	0.007	0.007	0	0.029	0.008
sour cream	300	26	25	0	0.002	0.008	0	0.040	0
brown gravy, homemade	301	26	22	4	0.002	0.005	0	0.020	0
French salad dressing, regular	302	26	24	2	0.004	0.013	0	0.057	0
Italian salad dressing, low-calorie	303	26	21	4	0.005	0.013	0	0.050	0
olive/safflower oil	304	26	26	0	0	0	0	0	0
coffee, from ground	305	26	22	4	0.001	0.003	0	0.010	0
fruit-flavored carbonated beverage	306	26	25	0	0	0.002	0	0.010	0
fruit drink, canned	307	26	25	1	0	0.001	0	0.004	0
martini	308	26	24	2	0.001	0.004	0	0.017	0
soy-based infant formula, ready-to-feed	309	26	26	0	0	0	0	0	0
egg yolk, strained/junior	310	12	10	2	0.002	0.006	0	0.018	0
rice infant cereal, instant, prepared with whole milk	311	26	21	5	0.003	0.006	0	0.021	0
rice cereal, strained/junior	312	20	15	5	0.003	0.005	0	0.016	0
bananas with tapioca, strained/junior	313	26	25	1	0	0.002	0	0.011	0
beets, strained/junior	314	15	11	4	0.002	0.004	0	0.009	0
split peas with vegetables and ham/bacon, strained/junior	316	26	23	2	0.003	0.010	0	0.050	0
teething biscuits	317	26	5	21	0.014	0.008	0	0.030	0.015
salmon, steaks or filets, fresh or frozen, baked	318	6	6	0	0	0	0	0	0
rice cereal with apple, strained/junior	319	4	2	2	0.005	0.006	0	0.011	0.004
squash, strained/junior	320	26	22	4	0.002	0.005	0	0.020	0

Appendix 3-B

Health Effects Associated with Exposure to Lead and Internal Lead Doses in Humans

**Source: U.S. Department of Health and Human Services, 1999.
Toxicological Profile for Lead. p. 23.**

Table 2-1. Health Effects Associated with Exposure to Lead and Internal Lead Doses in Humans

Duration of exposure	System	Effect	Blood lead levels at which effect was observed ($\mu\text{g}/\text{dL}$)	Reference
>1 year (occup)		Increase in death due to hypertension, nephritis, neoplasms	63–80	Cooper et al. 1985; Cooper 1988
NS (occup)		Increase in death due to cerebrovascular disease, nephritis, and/or nephrosis	NS	Fanning 1988; Malcolm and Barnett 1982; Michaels et al. 1991
>3 years (occup)		Increased incidence of death from lung cancer	34–58 (means)	Lundstrom et al. 1996
NS		Acute encephalopathy resulting in death in children	125–750	NAS 1972
2 weeks to >1 year (occup)	Cardiovascular	Increased blood pressure	≥ 30 –120	de Kort et al. 1987; Pollock and Ibels 1986; Marino et al. 1989; Weiss et al. 1986, 1988
>1 year (occup)	Cardiovascular	No effect on blood pressure	40 (mean)	Parkinson et al. 1987
>1 year (occup)	Cardiovascular	Ischemic electrocardiogram changes	51 (mean)	Kirkby and Gyntelberg 1985
NS (general population)	Cardiovascular	Increased blood pressure	44.9 (mean)	Khera et al. 1980b
NS (general population)	Cardiovascular	Increased systolic pressure by 1–2 mm Hg and increased diastolic pressure by 1.4 mm Hg with every doubling in blood lead level; effect most prominent in middle-aged white men	7–38	Coate and Fowles 1989; Harlan 1988; Harlan et al. 1988; Landis and Flegal 1988; Pirkle et al. 1985; Schwartz 1988; Proctor et al. 1996
NS (general population)	Cardiovascular	No significant correlation between blood pressure and blood lead levels	6–13 (median) or NS	Elwood et al. 1988; Grandjean et al. 1989; Neri et al. 1988; Staessen et al. 1990, 1991
NS (general population)	Cardiovascular	Degenerative changes in myocardium, electrocardiogram abnormalities in children	6–20	Silver and Rodriguez-Torres 1968
NS (children, environmental exposure)	Cardiovascular	1.8 mm Hg increase in systolic blood pressure increase and 0.9 mm increase in diastolic with blood lead increase from 10 to 30 $\mu\text{g}/\text{dL}$	37.3 (mean)	Factor-Litvak et al. 1996

Table 2-1. Health Effects Associated with Exposure to Lead and Internal Lead Doses in Humans (continued)

Duration of exposure	System	Effect	Blood lead levels at which effect was observed ($\mu\text{g/dL}$)	Reference
NS (acute) (general population)	Gastrointestinal	Colic in children	60–100	EPA 1986a; NAS 1972
NS (acute) (occup)	Gastrointestinal	Colic (abdominal pain, constipation, cramps, nausea, vomiting, anorexia, weight loss)	400–200	Awad et al. 1986; Baker et al. 1979; Haenninen et al. 1979; Holness and Nethercott 1988; Kumar et al. 1987; Marino et al. 1989; Matte et al. 1989; Muijser et al. 1987; Pagliuca et al. 1990; Pollock and Ibels 1986; Schneitzer et al. 1990
NS (occup)	Hematological	Increased ALAS and/or decreased ALAD	87 or NS (correlation with blood lead level)	Alessio et al. 1976; Meredith et al. 1978; Wada et al. 1973
NS (general population)	Hematological	Decreased ALAD	3–56 (adult) No threshold (children)	Chisholm et al. 1985; Hernberg and Nikkanen 1970; Lauwerys et al. 1978; Roels and Lauwerys 1987; Roels et al. 1976; Secchi et al. 1974
NS (occup)	Hematological	Increased urinary or blood ALA	>35 (adult) 25–75 (children)	Lauwerys et al. 1974; Meredith et al. 1978; Pollock and Ibels 1986; Selander and Cramer 1970; Solliway et al. 1996
NS (general population)	Hematological	Increased urinary ALA	>35 (adult) 25–75 (children)	NAS 1972; Roels and Lauwerys 1987
NS (general population)	Hematological	Increased FEP	≥ 25 –35	Grandjean and Lintrup 1978; Roels et al. 1975
NS (general population)	Hematological	Increased EP	30–40 (males) 20–30 (females)	Roels and Lauwerys 1987; Roels et al. 1975, 1976, 1979; Stuick 1974
NS (general population)	Hematological	Increased ZPP	≥ 15 (children)	Hammond et al. 1985; Piomelli et al. 1982; Rabinowitz et al. 1986; Roels and Lauwerys 1987; Roels et al. 1976
1–28 years (occup)	Hematological	Increased ZPP and urinary ALA	51 (mean) 40–75 (range)	Gennart et al. 1992a
NS (general population)	Hematological	Increased urinary coproporphyrin	≥ 35 (children ≥ 40 (adults)	EPA 1986a

Table 2-1. Health Effects Associated with Exposure to Lead and Internal Lead Doses in Humans (continued)

Duration of exposure	System	Effect	Blood lead levels at which effect was observed ($\mu\text{g}/\text{dL}$)	Reference
NS (general population)	Hematological	Decreased hemoglobin	≥ 40 (children)	Adebonojo 1974; Betts et al. 1973; Pueschel et al. 1972; Rosen et al. 1974
NS (occup)	Hematological	Decreased hemoglobin with or without basophilic stippling of erythrocytes	≥ 40	Awad et al. 1986; Baker et al. 1979; Grandjean 1979; Lillis et al. 1978; Pagliuca et al. 1990; Tola et al. 1973; Wada et al. 1973
NS (general population)	Hematological	Anemia (hematocrit of $<35\%$)	>20 (children)	Schwartz et al. 1990
NS (occup)	Hematological	Decreased Py-5'-N	NS	Buc and Kaplan 1978; Paglia et al. 1975, 1977
NS (general population)	Hematological	Decreased Py-5'-N	7–80 (children)	Angle and McIntire 1978; Angle et al. 1982
NS (acute) (general population)	Hepatic	Decreased mixed function oxidase activity	NS (children)	Alvares et al. 1975; Saenger et al. 1984
NS (chronic) (occup)	Renal	Chronic nephropathy	40 \rightarrow 100	Biagini et al. 1977; Chia et al. 1995a; Cramer et al. 1974; Lillis et al. 1968; Maranelli and Apostoli 1987; Ong et al. 1987; Pollock and Ibel 1986; Verschoor et al. 1987; Wedeen et al. 1979
1–30 years (occup)	Renal	No effect on renal function	40–75	Buchet et al. 1980; Huang et al. 1988a; Gennart et al. 1992a
NS (chronic) (general population)	Renal	Renal impairment with gout or hypertension	18–26	Batumen et al. 1981, 1983
NS (acute) (general population)	Renal	Aminoaciduria; Fanconi syndrome	>80 (children)	Chisolm 1962; Pueschel et al. 1972
NS (children, environmental exposure)	Renal	14% increase in NAG activity in urine per 10 $\mu\text{g}/\text{dL}$ blood lead	34.2 (mean)	Verberk et al. 1996

Table 2-1. Health Effects Associated with Exposure to Lead and Internal Lead Doses in Humans (continued)

Duration of exposure	System	Effect	Blood lead levels at which effect was observed (µg/dL)	Reference
0.2–20 years (chronic) (occup)	Endocrine	Decreased thyroxin (T ₄)	≥56	Tuppurainen et al. 1988
1–28 years (occup)	Endocrine	No effect on thyroid hormones, TSH, LH, and FSH	51 (mean) 40–75 (range)	Gennart et al. 1992a
NS (chronic) (general population)	Endocrine	No effect on thyroid function in children	2–77 (levels measured)	Siegel et al. 1989; Huseman et al. 1992
NS (general population)	Other	Negative correlation between blood lead and serum 1,25-dihydroxyvitamin D in children	12–120	Mahaffey et al. 1982; Rosen et al. 1980
NS (chronic) (general population)	Other	No effect on vitamin D metabolism in children	5–24 (levels measured)	Koo et al. 1991
NC (chronic) (general population)	Other	Growth retardation in children	≥30–60; tooth lead >18.7 µg/g	Angle and Kuntzelman 1989; Lauwers et al. 1986; Lyngbye et al. 1987; Huseman et al. 1992
NS (chronic) (general population)	Other	No association between blood lead levels and growth in children	10–47 (levels measured)	Greene and Ernhart 1991; Sachs and Moel 1989
NS (general population)	Other	Decreased growth rate	7.7	Shukla et al. 1989, 1991
NS (Mexican-American children)	Other	Decreased stature	≥9–10	Frisancho and Ryan 1991
<18 years (occup)	Immunological	Depression of cellular immune function, but no effect on humoral immune function	21–90	Alomran and Shleamoon 1988; Ewers et al. 1982
Mean, 6 years (occup)	Immunological	Decrease in some surface markers and IgG and IgM	38–100	Ündeger et al. 1996
Mean, 5.3 years (occup)	Immunological	No significant effects in wide range of tests	25–55	Pinkerton et al. 1998

Table 2-1. Health Effects Associated with Exposure to Lead and Internal Lead Doses in Humans (continued)

Duration of exposure	System	Effect	Blood lead levels at which effect was observed ($\mu\text{g}/\text{dL}$)	Reference
NS (acute)	Neurological	Encephalopathy (adults)	50–>300	Kehoe 1961a; Kumar et al. 1987; Smith et al. 1938
NS (older subjects, general population)	Neurological	Decreased performance in neurobehavioral tests	5.5 (mean)	Payton et al. 1998
NS (occup)	Neurological	No effect on neurobehavioral function in adults	40–60 (levels measured)	Milburn et al. 1976; Ryan et al. 1987
NS (occup)	Neurological	No effect on peripheral nerve function	60–80 (levels measured)	Ishida et al. 1996; Spivey et al. 1980
NS (acute and chronic) (occup)	Neurological	Neurological signs and symptoms in adults including malaise, forgetfulness, irritability, lethargy, headache, fatigue, impotence, decreased libido, dizziness, weakness, paresthesia	40–80	Awad et al. 1986; Baker et al. 1979; Campara et al. 1984; Haenninen et al. 1979; Holness and Nethercott 1988; Marino et al. 1989; Matte et al. 1989; Pagliuca et al. 1990; Parkinson et al. 1986; Pasternak et al. 1989; Pollock and Ibels 1986; Schneitzer et al. 1990; Zimmerman-Tanselia et al. 1983
NS (occup)	Neurological	Neurobehavioral function in adults; disturbances in oculo-motor function, reaction time, visual motor performance, hand dexterity, IQ test and cognitive performance, nervousness, mood, coping ability, memory	40–80	Arnvig et al. 1980; Baker et al. 1983; Baloh et al. 1979; Campara et al. 1984; Glickman et al. 1984; Haenninen et al. 1978; Hogstedt et al. 1983; Mantere et al. 1982; Maizlish et al. 1995; Spivey et al. 1980; Stollery et al. 1989, 1991, 1996; Valciukas et al. 1978; Williamson and Teo 1986
NS (occup)	Neurological	Peripheral nerve function in adults; decreased nerve conduction velocity	30–>70	Araki et al. 1980; Chia et al. 1996; Muijser et al. 1987; Rosen et al. 1983; Seppalainen et al. 1983; Triebig et al. 1984
NS (occup)	Neurological	Impaired postural balance	36 (mean)	Chia et al. 1996
NS (general population)	Neurological	Irritability, lethargy, behavioral problems and encephalopathy in children	60–450 (effects other than encephalopathy); >80–800 (encephalopathy)	Bradley and Baumgartner 1958; Bradley et al. 1956; Chisolm 1962, 1965; Chisolm and Harrison 1956; Gant 1938; Rummo et al. 1979; Smith et al. 1983

Table 2-1. Health Effects Associated with Exposure to Lead and Internal Lead Doses in Humans (continued)

Duration of exposure	System	Effect	Blood lead levels at which effect was observed ($\mu\text{g}/\text{dL}$)	Reference
NS (general population)	Neurological	Neurobehavioral function in children: slightly decreased performance on IQ tests and other measures of neuropsychological deficits	40–200	de la Burde and Choate 1972, 1975; Ernhart et al. 1981; Kotok 1972; Kotok et al. 1977; Rummo et al. 1979
NS (general population)	Neurological	Neurobehavioral function in children: slightly decreased performance on IQ tests and other measures of neuropsychological function	Tooth lead: 60–>30 $\mu\text{g}/\text{g}$ Blood lead: 6–60	Bellinger and Needleman 1983; Bergomi et al. 1989; Fulton et al. 1987; Hansen et al. 1989; Hawk et al. 1986; Needleman et al. 1979, 1985, 1990; Schroeder and Hawk 1987; Schroeder et al. 1985; Silva et al. 1988; Wang et al. 1989
NS (general population)	Neurological	No correlation between blood lead levels and permanent effects on neurobehavioral development in children	10–15	Bellinger et al. 1989a; Cooney et al. 1989a; Dietrich et al. 1987a; Ernhart and Greene 1990; Harvey et al. 1984, 1988; Lansdown et al. 1986; McBride et al. 1982; McMichael et al. 1986; Pocock et al. 1989; Smith et al. 1983; Winneke et al. 1984
NS (children, environmental exposure)	Neurological	Blood lead correlated with alterations in visual evoked potentials	range, 1.4–17.4	Altmann et al. 1998; Winneke et al. 1994
NS (children, environmental exposure)	Neurological	Impaired motor and cognitive function	40–50, 20 years before testing; current mean, 2.9	Stokes et al. 1998
NS (general population)	Neurological	Altered auditory evoked potential latency and decreased hearing acuity in children	4–60	Holdstein et al. 1986; Robinson et al. 1985; Schwartz and Otto 1987
NS (children, environmental exposure)	Neurological	No evidence of auditory dysfunction	range, 6.2–128.2	Counter et al. 1997
NS (general population)	Neurological	Postural disequilibrium	11.9 geometric mean for first 5 years of age	Bhattacharya et al. 1993

Table 2-1. Health Effects Associated with Exposure to Lead and Internal Lead Doses in Humans (continued)

Duration of exposure	System	Effect	Blood lead levels at which effect was observed ($\mu\text{g}/\text{dL}$)	Reference
NS (general population)	Neurological	Peripheral neuropathy and reduced conduction velocity in children	20–30	Erenberg et al. 1974; Landrigan et al. 1976; Schwartz et al. 1988; Seto and Freeman 1964
Prenatal (general population)	Developmental	Reduced birth weight and/or reduced gestational age, and/or increased incidence of stillbirth and neonatal death	12–17	Bornschein et al. 1989; McMichael et al. 1986; Moore et al. 1982; Ward et al. 1987; Wibberley et al. 1977
NS (general population)	Developmental	No association between blood lead levels and birth weight, gestational age, or other neonatal size measures	3–55	Factor-Litvak et al. 1991; Greene and Ernhart 1991
NS (general population)	Developmental	Impaired mental development in children	10–15	Baghurst et al. 1987; Bellinger et al. 1984, 1985a, 1985b, 1986a, 1986b, 1987a, 1987b; Bornschein et al. 1989; Deitrich et al. 1986, 1987a, 1987b; Ernhart et al. 1985, 1986, 1987; McMichael et al. 1988; Rothenberg et al. 1989a; Tong et al. 1996; Wigg et al. 1988; Winneke et al. 1985a, 1985b; Wolf et al. 1985; Vimpani et al. 1985, 1989
NS (general population)	Developmental	Impaired motor developmental status in 6-year-old children (Cincinnati cohort)	≥ 9.0 (mean lifetime)	Dietrich et al. 1993b
NS (general population)	Developmental	Moderate deficit in Wechsler Performance IQ in children 6.5 years old (Cincinnati cohort)	≥ 20 (average lifetime)	Dietrich et al. 1993a
NS (general population)	Developmental	Lower scores in test of Cognitive Function at 5 and 10 years of age	6.5 (mean at 24 months of age)	Bellinger et al. 1991, 1992
NS (general population)	Developmental	Inverse correlation between blood lead levels and ALA and ALAD activity	10–33 (mean)	Haas et al. 1972; Kuhnert et al. 1977; Lauwerys et al. 1978
NS (children, environmental exposure)	Developmental	Small association between abnormal behavior and blood lead at age 3	40.9 (geometric mean)	Wassermann et al. 1998
NS (occup)	Reproductive	Decreased fertility	37.2 (mean)	Lin et al. 1996

Table 2-1. Health Effects Associated with Exposure to Lead and Internal Lead Doses in Humans (continued)

Duration of exposure	System	Effect	Blood lead levels at which effect was observed (µg/dL)	Reference
NS (general population)	Reproductive	Increased incidence of miscarriages and stillbirths in exposed women	≥ 10 or NS	Baghurst et al. 1987; Hu et al. 1991; McMichael et al. 1986; Nordstrom et al. 1979; Wibberley et al. 1977
NS (general population)	Reproductive	No association between blood lead levels and the incidence of spontaneous abortion in exposed women	2	Murphy et al. 1990
NC (occup)	Reproductive	Low sperm count, decreased sperm mobility, abnormal sperm	40–50	Alexander et al. 1996; Assennato et al. 1987; Braunstein et al. 1978; Chowdhury et al. 1986; Cullen et al. 1984; Lancranjan et al. 1975; Rodamilans et al. 1988; Wildt et al. 1983

ALA = δ-aminolevulinic acid; ALAD = δ-aminolevulinic acid dehydratase; ALAS = δ-aminolevulinic acid synthase; EP = erythrocyte protoporphyrins; FEP = free erythrocyte protoporphyrins; FSH = follicle stimulating hormone; IQ = intelligence quotient; LH = luteinizing hormone; NS = not specified; (occup) = occupational; Py-5¹-N = pyrimidine-5-nucleotidase; TSH = thyroid stimulating hormone; ZPP = erythrocyte protoporphyrin